LARGE EDDY SIMULATION OF MULTIPHASE REACTING FLOWS IN COMPLEX COMBUSTORS

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Large-eddy simulation (LES) is a promising technique to accurately predict reacting multi-phase flows in practical combustors involving complex multiscale phenomena of turbulent mixing and combustion dynamics. We have developed a non-dissipative, massively parallel, unstructured grid solver (CDP) for LES in realistic configurations. An Eulerian low-Mach number formulation on arbitrary shaped unstructured grids is used to compute the gaseous phase. A new numerical algorithm that is discretely energy conserving on hybrid unstructured grids is developed. This allows simulations at high Reynolds numbers without use of numerical dissipation. The LES methodology is extended to include advanced turbulent combustion models based on the flamelet theory. A Lagrangian formulation is used to represent the dispersed phase with hi-fidelity models to capture liquid-sheet breakup, droplet deformation and drag, and evaporation. Results from several single and two-phase flow simulations in academic as well as realistic Pratt & Whitney combustors are discussed.